

Basic Kinetic Modeling in PET and MR Imaging

February 27 – March 3, 2023

Teachers

- (GMK) Gitte Moos Knudsen, professor, MD, Neurobiology Research Unit, Rigshospitalet (course director)
(HL) Henrik B.W. Larsson, professor, MD, PhD, Functional and Diagnostic MR Unit, Rigshospitalet (course Director)
(SC) Stig Præstekjær Cramer, MD, PhD, Functional Imaging Unit, Rigshospitalet Glostrup
(AEH) Adam Espe Hansen, Professor, MSc, PhD, Dept Diagnostic Radiology, Rigshospitalet
(AL) Adriaan Lammertsma, Professor, University Medical Center Groningen, The Netherlands
(GL) Gjertrud Laurell, PhD student, Neurobiology Research Unit, Rigshospitalet
(IL) Ian Law, Professor, MD, DMSc, Dept. Clinical Physiology, Rigshospitalet
(UL) Ulrich Lindberg, MSc, PhD, Functional Imaging Unit, Rigshospitalet Glostrup
(LM) Lisbeth Marner, MD, DMSc, Dept. Clinical Physiology/Nuclear Medicine, Bispebjerg Hospital
(MP) Mikael Palner, MSc, PhD, Neurobiology Research Unit, Rigshospitalet
(PS) Pontus Plavén-Sigray, PhD, Neurobiology Research Unit, Rigshospitalet
(MS) Martin Schain, MSc, PhD, Antaros Medical
(CS) Claus Svarer, PhD, Neurobiology Research Unit, Rigshospitalet
(MV) Mark Vestergaard, MSc, PhD, Functional Imaging Unit, Rigshospitalet Glostrup

Location

Rigshospitalet, NF2, entrance 7-8, Inge Lehmanns Vej 6-8, DK-2100 Copenhagen Ø
Monday, Wednesday and Thursday: Ground floor, room 12.00.8523 (located between entrance 7 and 8)
Tuesday and Friday: NRU conference room, entrance 8, 5th floor

Monday, February 27, 2023

- 09.00-9.30 Introduction (GMK, CS, HL)
Presentation of the individual participants. Please prepare a short presentation of yourself and the relation of tracer kinetics to your project.
9.30-10.00 Basic mathematics, exponentials, compartment modelling and differential equations (GL)
10.00-10.30 Basic physiology, blood, tissue and Blood Brain Barrier (GMK)
10.30-11.00 **Coffee break**
11.00-12.30 Basic tracer kinetic concepts: Steady state, linearity, stationarity etc. (MV)
12.30-13.30 **Lunch**
13.30-14.30 Clearance and Fick's principle, including examples (SC)
14.30-15.30 PC exercise 1 (intro, basics) (CS, GMK, PS, GL)
15.30-16.30 Extraction, Renkin-Crone model, examples of determination of permeability (SC)

Tuesday, February 28, 2023

- 09.00-10.00 Bolus injection (HL)
10.00-11.00 Impulse response, convolution (HL)
11.00-12.00 Mean transit time, external residue detection (HL)
12.00-13.00 **Lunch**

Tuesday, February 28, 2023 (continued)

- 13.00-14.00 System theory (HL)
14.00-15.00 PC exercise 2 (convolution, extraction) (CS, GMK, PS, GL)
15.00-16.00 Kety-Schmidt – Examples (HL)

Wednesday, March 1, 2023

- 09.00-09.45 Introduction to positron emission tomography (PET) and single photon emission tomography (SPECT) (MS)
09.45-10.30 PET and SPECT kinetics (MS)
10.30-10.45 **Coffee break**
10.45-12.00 Receptor kinetics (MS)
12.00-13.00 **Lunch**
13.00-14.00 Why modelling is important – the need for quantification (AL)
14.00-15.00 Determination of glucose consumption, deoxyglucose method (PS)
15.00-16.00 PC exercise 3 (models and rate constants) (CS, MS, PS, GL)

Visit to the PET department in order to see the local setup for, e.g., blood sampling, PET, and new combined PET/MR scanner.

Thursday, March 2, 2023

- 09.00-10.00 Testing new radioligands and pharmacology development (GMK)
10.00-11.00 Reference tissue modeling (CS, LM)
11.00-12.00 PC exercise 4 (linearization and reference tissue modeling) (CS, GMK, LM, GL)
12.00-13.00 **Lunch**
13.00-14.00 Introduction to magnetic resonance imaging (MRI) (AEH)
14.00-15.00 Measurements of heart perfusion using dynamic contrast enhancement and T1 weighted MRI (UL)
15.00-16.00 Measuring brain perfusion with Dynamic Susceptibility Contrast MRI (AEH)
16.00-17.00 PC exercises (MR) (AEH, CS)

Friday, March 3, 2023

- 09.00-09.45 Measurement and estimation of flow in brain, heart, liver, muscles, and kidneys using H₂O PET techniques (IL)
09.45-10.30 Plenum discussion of course material (HL, UL, CS, GMK)
10.30-11.15 Small animal imaging (MP)
11.15-12.00 Blood flow measurements using MR Arterial Spin Labelling (UL)
12.00-12.30 PC exercise 5 (guess a model and wrap-up) (CS, GMK, GL)
12.30-13.00 **Lunch**
13.00-14.00 Example of analysis and kinetic modeling of a dynamic brain PET dataset using standard software like PVElab and PMOD (CS)
14.00-14.30 Discussion of the course participants own projects - bring material from your own project that you want to share and discuss (GMK,CS,HL)